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Chapter

The Harvest and Post-Harvest Management Practices' Impact on Coffee Quality

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Abstract

Coffee is one of the most important agricultural commodities in the world. The coffee quality is associated with pre-harvest and post-harvest management activities. Each step starting from selecting the best coffee variety for plantation until the final coffee drink preparation determines the cupping quality. The overall coffee quality influenced by the factors which involve in changes the physicochemical properties and sensorial attributes, including the post-harvest operations. The post-harvest processing activities contribute about 60% of the quality of green coffee beans. The post-harvest operations include pulping, processing, drying, hulling, cleaning, sorting, grading, storage, roasting, grinding, and cupping. This chapter comprises the harvest and post-harvest operations of coffee and their impacts on coffee quality.

Keywords: digestive bioprocessing, coffee cherry, caramelization, Maillard reaction, speciality coffee

1. Introduction

Coffee trees are widely grown in tropical and subtropical regions of Africa, Southeast Asia, and South America [1]. The world annual coffee production estimated 158.6 million 60-kg bags as of 2017/2018, up from 148.6 million 60-kg bags in 2014/2015. South America, Asia and Oceania, Mexico and Central America, and Africa produced as presented, respectively, 81.5, 47.7, 21.7, and 17.8 million 60-kg bags of coffee. The genus *Coffea* belongs to the *Rubiaceae* family and holds more than 90 different species. However, only *Coffea arabica*, *Coffea canephora*, and *Coffea liberica* are commercially important [1]. Arabica coffee accounts for about 64%, while *C. canephora* accounts for about 35% of the world's production; other species with not much commercial value like *Coffea liberica* and *Coffea excelsa* represent only 1% [2]. The quality of coffee is affected by a series of multiple factors. In broad categories, two factors affect coffee quality, namely, pre-harvest and post-harvest factors [3]. The pre-harvest factors set approximately 40% of the sensory attributes and physical and chemical properties of the coffee beans and the remaining 60% of the coffee quality established by the post-harvest processing [4]. Following harvesting, coffee cherries go through a complex series of post-harvest processing steps to be in a more stable, transportable, and roastable form. The initial post-harvest processing steps have a significant role in ensuring the safe changes of the perishable coffee cherries into moderately stable green coffee beans. These green coffee beans have a moisture content of 10–12% to avoid undesired fermentation [5]. The popularity of the coffee product is associated with its distinctive organoleptic properties. Post-harvest management activities conducted to obtain suitably dried coffee beans for roasting and significantly contribute to the quality of the coffee beverage [6]. Post-harvest processing changes the chemical composition of green coffee beans that directly or indirectly influences the quality and end products [3, 7, 8]. These activities include a series of complicated steps including cherry harvesting, de-pulping, fermenting, drying, storage, and others. The number of activities varies according to the type processing method. Right after the on-farm post-harvest process is finished, the coffee can be brought to the coffee industry where the semi-manufactured or complete products are made for commercialization [9].

2. Coffee harvesting and its impact on coffee quality

Production of speciality coffee needs a proper plan for harvesting the coffee cherries as it gives good economic returns for producers. The time of harvest varies in different places. According to the processing method to be implemented, harvesting the coffee cherries without causing damage to the tree is an important task. In most of the coffee-producing countries, coffee is harvested once per year. As the coffee cherries mature, the coffee fruit contains suitable chemical compositions which lead the fruit to the best quality [10]. The coffee fruit also contains volatile compounds that are responsible for the aroma and flavour properties of the coffee. These compounds are present at a very low amount at the early stage of the coffee cherry, but later on, it increases as the coffee transformed to the maturity stage [10]. There are two strategies (strip and selective picking) for harvesting the coffee cherries, which are widely used.

2.1 Strip picking

This strategy is usually done by machinery or by hand. The whole coffee cherries are harvested at one time. The harvested coffee may not achieve the desired quality due to the mixture of underripen or overripen coffee cherries. In order to use machinery for harvesting the coffee cherry, the following factors are critically important such as the topography, inclination, spacing, alignment, and the height of

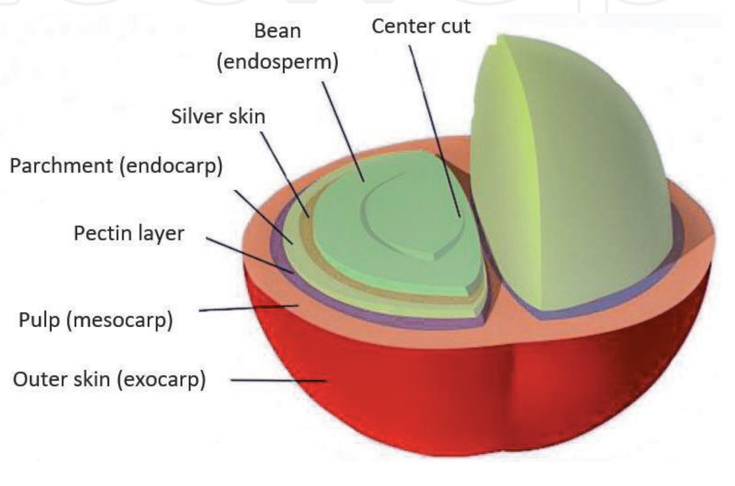

Figure 1.
The coffee cherry anatomy.

Components	%
Ether extract	0.48
Crude extract	21.4
Crude protein	10.1
Ash	1.5
Nitrogen-free extract	31.3
Tannins	7.8
Pectin substance	6.5
Non-reducing sugars	2.0
Reducing sugars	12.4
Chlorogenic acid	2.6
Caffeine	2.3
Total caffeic acid	1.6

Adapted from Gathuo et al. [13].

Table 1.
Composition of coffee pulp.

Components	Concentration (g/L)
Glucose	35.65
Galactose	37.67
Lactose	1.06
Proteins	0.119
Syringaldehyde	0.610
Minerals	**(mg/L)**
Sulphur	30.19
Calcium	37.08
Potassium	239.8
Magnesium	10.05
Phosphorus	41.55
Sodium	7.18
Iron	0.65
Copper	2.45
Zinc	0.14
Manganese	0.07
Boron	0.16
Barium	0.02
Arsenic	0.47
Lithium	0.01
Silicon	1.58
Strontium	0.07

Adapted from Pérez-Sariñana et al. [14].

Table 2.
Chemical composition of coffee mucilage.

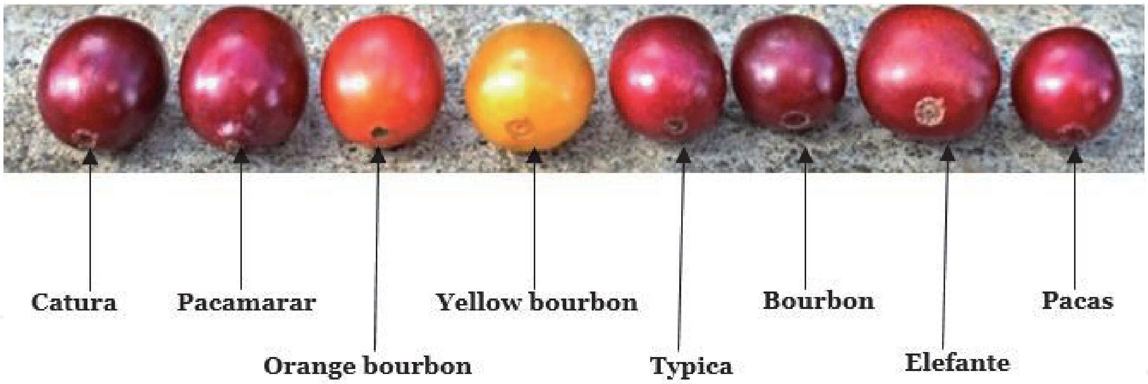

Figure 2.
The cherries of different varieties of Coffea arabica.

the plant [11]. Considering these factors, the producer should choose the right harvesting system that suits their crop.

2.2 Selective picking

The major challenges in the coffee sector are obtaining uniform maturity, and at the same time, it is the procedure to provide consistent quality coffee. It is important to note that in most flowering plants the climatic condition during the growing period can change the number of flowering plants which affect the maturation uniformity [12]. In this harvesting system, only the ripened coffee cherries are harvested selectively by hand from the whole tree or branches. The harvested coffee meets the standards due to the uniformity of the cherries. This strategy needs several picking rounds and is labour-intensive. Considering the advantage and disadvantages of both harvesting strategies is the key for coffee growers. The coffee cherry has different layers that surround the beans, such as skin, pulp, mucilage, parchment, silver skin, and finally, the coffee beans (**Figure 1**).

The pulp and mucilage are rich in nutrients, and its chemical compositions are presented in **Tables 1** and **2**. These days the coffee pulps are being used for making a coffee wine by fermenting the coffee pulp. So far, there are two patents already registered in Korea. The ripe coffee cherries have colour ranges from bright red to deep red and yellow, depending on the plant variety and for ripe cherries. The different varieties of arabica coffee cherries are presented in **Figure 2**.

3. Post-harvest operations and their impact on coffee quality

3.1 Coffee processing methods

After harvesting of the fruits, green coffee beans are obtained by one of three different methods known as dry, wet, and semi-dry processing [15]. Commonly, there are three different coffee processing methods (**Figure 3**). These methods are wet, dry, and semi-dry processing, and recently, digestive bioprocessing is practised on a small scale to produce the world's most expensive coffee (kopi luwak and black ivory coffee). Although all methods aim at removing the fruit flesh of coffee cherry, they do it in different ways [16]. After harvesting, the coffee cherry follows washing with water to separate floaters (overripe coffee cherries, undeveloped coffee cherries, sticks and leaves). Those processing methods are briefly described below.

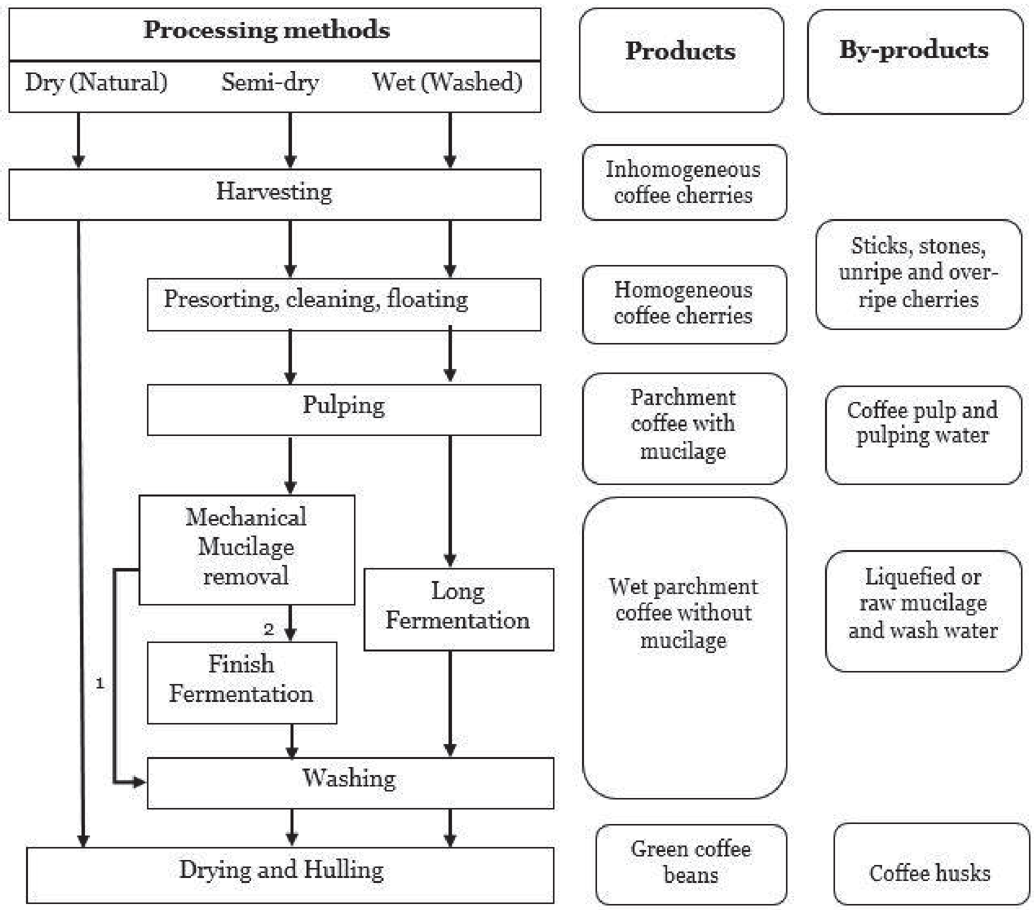

Figure 3.
Coffee processing methods.

3.1.1 Wet processing

This processing method demands the use of some particular facilities and ample amounts of water. When this method adequately implemented, it maintained the inherent quality of coffee beans and produced uniform green coffee beans with minimum defectives. Arabica coffee is widely obtained using wet-processing method except in some countries like Ethiopia, Brazil, and Yemen where they processed in both wet- and dry-processing system, although few percentages of robusta coffee are obtained in this method. Right after harvesting, the coffee cherries are washed and then de-pulped using a machine. The coffee mucilage has pectin substances (polysaccharides), and it has a sticky nature and is challenging to get rid of using water. After de-pulping, chemicals mostly enzymes used to remove mucilage or the natural fermentation proceeds depend upon the environmental condition and fruit ripeness [15]. Natural plant enzymes are present in the coffee fruit that facilitates the degradation of mucilage; however, it is not enough for a full and sufficient process [17]. Microorganisms are responsible for degrading the polysaccharide substances from the parchment coffee. Finally, after fermentation the end product is a "parchment" or "washed" coffee [18]. The type of coffee processing methods (wet and dry) that are performed to obtain the green beans determined the flavour properties and created a typical quality difference [3, 19]. Several reports also stated the final cup quality and chemical composition are also defined by the adopted method in wet processing [20–22]. The effect of different modified wet-processing methods on the final quality of coffee is evaluated and compared by Gonzalez-Rios et al. [21]. Coffee obtained using wet-processing method is considered as a high-quality coffee and received a higher price compared to dry-processed (natural) coffee [23]. A study showed that during processing, several metabolic activities are exhibited in green coffee beans [24, 25]. These metabolic changes occur mainly because of the germination processes, [26] and stress metabolism is a cause for notable differences in the chemical composition of the green coffee beans and thereby determines the quality [27].

As mentioned above, fermentation is a crucial step in wet processing. Diverse microorganisms are existing during fermentation in wet processing [28]. The reason for an excellent microbial population during wet-processing method is because of the nutrient-rich pulp and mucilage. However, microbial heterogeneity subjects to distinction depending upon geographical features, the composition of the coffee fruit, and the fermentation methods [29–31]. These microorganisms are consuming the nutrients in the pulp and mucilage and are responsible for producing different metabolites and organic acids, which are then stored in the coffee beans and may affect the coffee quality. The variations of microorganisms diversity and environment may lead to the difference of the type of these organic acids and metabolites or the amount to which they produced and therefore provide different unique coffee qualities [32, 33].

3.1.2 Semi-dry (semi-wet) processing

The semi-dry (pulped natural) processing is an intermediate process between wet and dry processing. Like wet processing, the coffee exocarp and significant portion of mesocarp are separated while de-pulping is operated. However, unlike wet-processing method, the sticky part (mucilage) remains and is allowed to dry on the parchment instead of complete removal of it with further fermentation until 11–12% moisture content is achieved [34]. After drying the parchment coffee in well-aerated raised beds or cement patios, the coffee bean is then separated from its parchment using machine or any locally available materials like wooden mortar in small scale farms. Despite having less body compared to naturally processed (dry) coffee beans, the cup quality of semi-dry-processed coffee has a bright and clean cup and is somewhat similar to wet-processed beans [35, 36]. A comparison of the primary and secondary metabolites of coffee, which processed by the wet and semi-dry (semi-wet) method was comprehensively investigated [38]. These metabolites are supposed to be very important, because during roasting their degradation results in the development of those nonvolatile or volatile compounds essential for the formation of coffee properties, pigmentation, bitterness, body, astringency, sweetness, aroma, and so on [38–40]. A very similar result between semi-wet- and wet-processed coffees was found regarding the distributions of nine chlorogenic acid classes (3-CQA, 4-CQA, 5-CQA, 3-FQA (feruloylquinic acid), 4-FQA, 5-FQA, 3,4-di-CQA, 3,5-di-CQA, and 4,5-di-CQA), but the total CGA content was statistically lower in semi-wet-processed coffee except for di-CQA [37]. The reason for low CGA content in semi-washed beans might be associated with soaking water for a shorter time which leads to the loss of water-soluble components due to leaching and fermentation [14, 41]. Generally, semi-dry-processing methods are more regularly practised in only Brazil and some parts of Sulawesi and Sumatra.

3.1.3 Dry processing

Dry processing is the oldest, cheapest, and simple processing method. The coffee beans that are obtained using dry-processing method are usually called unwashed (natural) coffee. In this processing method, to get the green coffee beans, the harvested cherry is dried in the sun or other mechanical drier and followed by separating the dried outer parts [22]. Sun drying is a lengthy process, and 95% of

Arabica coffee from Brazil, Ethiopia, Haiti, Indonesia, Paraguay, India, and Ecuador are sun-dried [42]. Few steps are involved in this processing method compared to wet- and semi-dry-processing methods. It is a time-consuming processing as the whole coffee cherry takes some time to dry compared to drying the parchment coffee in wet processing. Dry processing has a high risk of secondary fermentation because of the mucilage, which is very hygroscopic remains with the coffee cherry [43]. The fruits are spread over thin layer and regularly raked to maintain uniform temperature from the top-bottom layer. The drying step in anywhere may take from 10 days to 3 weeks. However, the geographical location and seasons affect the drying process. In some big farms, the mechanical drier is used to speed up the drying process. Because of the existing lowland high temperature and condensation effect, it speeds up the drying process of coffee beans more quickly at the surface (cement or bricks) than raised bed, which is made of mesh wire or bamboo mats. Drying is the most critical step in this processing method because it affects the final quality of the coffee. The overdried fruits have brittle characteristics and produce many defective (broken) during hulling; however, on the other side, under-dried fruits are highly exposed to deteriorations because of fungus and bacteria growth [22]. Tadesse et al. [44] reported that the number of imperfect beans with musty, earthy and greenish colour coffee defects frequently found in dry processed coffee. The bean size and roast volume of dry-processed coffee beans were larger, whereas the wet-processed coffee beans have a higher moisture content [44]. However, concerning the physical parameters (colour, shape, size) dry-processed coffee beans are no longer regarded as better than wet-processed. Coffee beans that are obtained with dry-processing method are heavy in body, smooth, and sweet and have complex characteristics.

3.1.4 Digestive bioprocessing

The world most expensive coffees are obtained through digestive bioprocessing method. This processing method is rare and applied on a small scale. Digestive bioprocessing is a way of passing the coffee cherry through the animal intestine or digestive tract, which is the coffee beans exposed for acids, enzymes, and fermentation treatments. The coffee cherries are eaten by the civet cat and passed through the digestive system to produce civet coffee (kopi luwak) in Indonesia [45]. Similarly, elephant dung coffee (black ivory coffee), produced after the coffee cherries passed through the elephant's digestive tract, which is commonly produced in Thailand. During civet digestion, the breaking down of proteins creates a unique flavour and aroma of civet coffee [45]. The annual production of kopi luwak is less than 500 pounds, and the price is 600 dollars (Canadian) per pound; it leads the indisputable status of being the most expensive and rarest coffee in the world. Currently, we are working on analysing the elephant dung coffee, and it is compared with other coffees that are processed with commonly known processing methods (dry and wet processing) (data not shown). The experiments were conducted in Nepal. The coffee cherries were harvested and fed by the elephants. Then the parchment coffee (the skin and pulp completely digested) and coffee cherry (the pulp is not digested) were collected from the elephant dung (**Figure 4**), and washing, drying, and other processes to obtain the green beans are continued. The black ivory coffee has a price tag of 1000 USD per kilogramme bean. This price makes it one of the world's expensive coffees.

3.2 Drying

Drying is the most critical steps in coffee processing methods. Drying is performed to reduce the moisture contents of coffee bean to the required level

Figure 4.
Elephant dung coffee preparation in Nepal.

(10–12%) and to separate the parchment from the coffee beans easily. Sufficient drying is a crucial step to avoid the developments of moulds, which leads to significant losses and affects coffee quality. The drying methods were significantly affected the amount of low molecular weight (LMW) carbohydrates that present in the green coffee beans [47]. Several researchers reported the responses of coffee to various drying processes. The coffee cherry kinetics and drying characteristics under different drying temperature (40, 50, and 60°C) were investigated [47]. The effect of drying and storage conditions on the quality of washed and natural coffee was evaluated by Coradi et al. [48]. This research was focused on the relevance of suitable drying along with sufficient storage conditions to maintain the coffee quality. There are two ways for drying the coffee, such as natural drying using sunlight and mechanical drier.

3.2.1 Sun (natural) drying

This drying method is the most common, widely practised in many countries and the cheapest way of drying the parchment coffee or the whole coffee cherry. This activity is highly dependent on climatic conditions and seasons. The removal of the mucilage and pulps at an early stage in wet-processing reduces the time needed for drying. There are different kinds of sun-drying methods. Coffee is typically dried on large patios made of cement or asphalt concrete with a 0.5–1% slope to drain the water. Using the natural sunlight, drying of coffee takes 7–15 days for parchment coffee and 12–21 days for coffee cherries in patios. This duration varies depending on the weather conditions. The parchment coffee needs special attention than cherries to reduce physical damage (cracking). Raking is required to allow the coffee to dry uniformly, but it should be carried out carefully. In some tropical countries, during the hottest hours of the day, covering sheets used to avoid the cracking of the coffee beans because of overheating. The physicochemical characteristics of coffee that are dried on various types of drying grounds and the thickness of the layers (thin and thick) were evaluated by Reinato et al. [49]. Their result showed the wet-processed parchment coffee dried on thin layer which resulted in the best beverage quality.

3.2.2 Mechanical driers

During the mechanical drying, the beans are heated by hot air that passes through the machine and dries the coffee. Also, it carries away the moistures from the drying coffee. Controlling the drying temperature is the most critical part, and it should not exceed 45°C for whole cherries and 40°C for parchment coffee. Commonly there are two kinds of mechanical drier, such as static and revolving driers. Revolving driers include column driers, vertical driers, rotary driers, cascade driers, and flex driers, and there are tray driers with a stirrer [50]. All these driers can work with fuel oils, gasses, woods, and other energy sources. A report indicated that the best quality coffee was gained when the drying processes were done at two stages, an initial period the drying was performed at low temperature (20°C) and the second stage followed by higher temperature (60°C) [51].

3.3 Hulling and sorting

Hulling is the next step after drying. The dried coffee cherries (dry-processed) or parchment coffee (wet-processed) hulled to remove the covers and get the coffee beans out of it. Once the coffee bean reaches this stage, it means all the essential quality, such as colour and moisture content, has already been achieved. Hulling is done by using different hulling machines, or locally on a small-scale farm, wooden mortar and pestle used to separate the coffee beans from the parchment or dried coffee cherries. Commonly there are two kinds of coffee hulling machines. One is which rubbed off the parchment by friction, and this might create heat. The second type is just cut the parchment and stripped off. It is essential to take care of the coffee beans and avoid physical damage even not to heat the beans during hulling because it affects the colour and taste of the coffee. The last layer that encloses the coffee beans is thin silver skin, and this may be removed or may not be removed during the hulling process. If the coffee beans' silver skin is not separated during hulling; it needs a machine called polishers to separate it and get the green coffee beans. Finally, the green coffee beans are ready to be cleaned and sorted according to colour, size, and density [52].

The hulled coffee beans then undergo sorting processes, which is done by machine and hand. Hand sorting is most widely used, and it requires intensive labour for sorting the coffee beans based on size, colour, and density. The same-size and larger coffee beans get a premium price in the market, and a high percentage of defect may lead to a lower grade, and the price is also low [53]. Sorting is a crucial step because it affects the roasting condition. Uniform size coffee beans should be roasted to achieve uniform roasted beans. Sieve machines are used to screen the coffee beans according to their size. The sieving principle is applied in the sorting machine, which is using a big vibrating flatbed [54]. There are different kinds of machines used to sort coffee beans. Electronic devices are also used to separate the coffee beans by their colours. However, this is not always sufficient to detect and separate the good and bad coffee beans. After sorting is properly done, the coffee beans are then packed with the right packaging materials and transferred to the storage house.

3.4 Storage

Right after the coffee beans are graded, they have to be kept in a storage house until they shipped and sold in the market. The temperature and relative humidity of the storehouse should be controlled to maintain the coffee quality without losing its intrinsic sensorial characteristics and physical and chemical properties and to store for a longer time. Afonso [55] reported that as the storage relative humidity is higher for an extended time, it decreases the compositions of reducing sugars in green coffee beans. Several research reports are available about the effects of storage conditions on the sensorial quality of coffee beans. He also mentioned that the 60% relative humidity with longer storage causes to cellular degradation and leads to oil leaking, which also contributes to the chemical compositions of green coffee beans. When the storage duration is prolonged, the oil becomes more acidic, and it reduced the quality of the product [54].

3.5 Roasting, grinding, and drewing

The most critical factor in the coffee value chain is roasting, where the physicochemical changes lead to the fulfilment of the roasted coffee characteristics [55]. Roasting is considered the essential steps in the formation of the aroma and flavour properties [56]. The essential reactions during coffee roasting and which are responsible for the colour, volatile compounds, and flavour developments are called Maillard reaction and caramelization. Minerals are vital catalysts in the various biochemical reactions responsible for the formation of different aroma and flavour compounds [57]. Amino acids have an important role in the formation of nitrogen/sulphur heterocyclic compounds called melanoidins during roasting because of Maillard reaction or caramelization, which are considered as crucial compounds for flavour development [58]. When the roasting temperatures are higher than 200°C, the precursors in green coffee are transformed into roasted coffee constituents, which lead to the development of diverse aroma test and colour [59]. However, the coffee's intrinsic quality is predetermined in the green bean by its precursor composition, and the roaster only can unlock the full potential by applying the appropriate and optimised roasting conditions. Optimising the appropriate roasting conditions is undoubtedly the most critical ways for achieving the desirable coffee aroma [60]. Fobe and his co-workers [61] reported that as the roasting time is extended, the following changes occurred: the sugar content is reduced and then raised; caffeine contents showed insignificant changes; protein continuously decreased; free fatty acid improved; and unsaponifiable compounds declined. Another report mentioned that the lipid and organic acid increased, while the trigonelline and caffeine content showed almost unchanged [60]. During roasting net losses of matters in the form of water vapour, $CO_{2,}$ and volatile compounds are exhibited. The roasting duration and the final temperature of the coffee beans determine the development of flavour compounds [62]. A different flavour profile may occur because of the time–temperature and roasting conditions, even though the same coffee beans and roaster are used [63]. The physical properties and kinetics of aroma development of coffee showed differences as the coffee is roasted for a shorter time at high temperature compared to beans roasted for a longer time at low temperature [64, 65]. Fast roasting generates more soluble solids and causes less degradations of CGA, and the loss of volatile was lower [66]. However, the fast roasted coffee is considered affected by lipid oxidation because of high migration of oil from the inner part of the coffee beans to the surface [1]. The determining factors of the final coffee quality are roasting profile, roasting degree, and the technology used for coffee roasting. There are different kinds of roasting conditions. The most common roasting types are discussed below.

3.5.1 Light roast

The lightly roasted coffee developed light brown colour, and it is preferred to make a coffee with a mild body. It has light fragrant, floral or fruity coffee notes. In this roasting condition, the coffee beans should not develop oil on their surface. It is also characterised with pronounced acidity and high caffeine content. During light roasting, the internal temperature of the coffee bean reached approximately 204°C (**Figure 5A**).

3.5.2 Medium roast

Medium roasted coffee developed medium brown colour, and the surface of the coffee beans should not have oils. It is characterised by balanced aroma flavour and acidity. Traditionally this is the most preferred roasting condition. It has medium caffeine content. To achieve this roasting condition, the internal temperature of the coffee beans reached approximately 215°C (**Figure 5B**).

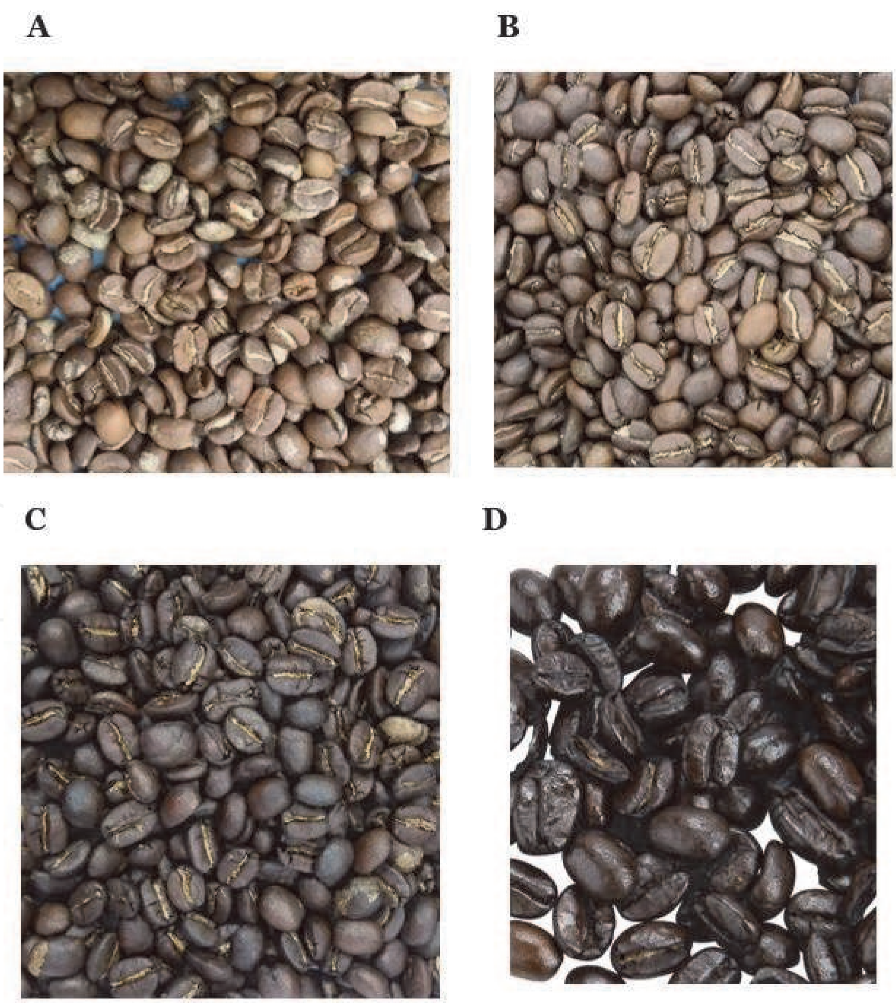

Figure 5.
The most common types of roasting conditions (A, light roast; B, medium roast; C, medium-dark roast; D, dark roast).

3.5.3 Medium-dark roast

Medium-dark roasted coffee has a dark brown colour, and the surface of roasted beans developed oils. It is characterised by fully bodied deep flavoured and little spicy notes. It has low caffeine content. This roasting condition is attained when the internal temperature of the coffee bean reached nearly 229°C (**Figure 5C**). Overall, roasting coffee in medium to dark conditions causes an increase in ketones, esters/lactones, aldehydes, aliphatic acids, and aromatic acids, but a reduction in caffeine content is observed [67–69].

3.5.4 Dark roast

It has nearly a dark colour and produced oils on the surface of the coffee beans. The darker the coffee beans, the less the acidity. It is also characterised by very low caffeine content with heavy mouthfeel, strong flavour, bitter, and burnt or smoky notes. When the coffee is roasted in the dark condition, the internal temperature of the coffee beans reached approximately 246°C (**Figure 5D**).

Grinding is the next step after roasting. In this step, the coffee beans are crushed and changed into powder at different particle size. It is done using a grinding machine (electrical) or using mortar. However, to achieve a uniform ground size, an electrical grinder is the best choice. Blenders can also be used for grinding coffee beans, and the larger particle size and the broadest distributions can be seen while blending the coffee beans [70]. The grinding size is usually measured by using sieve analysis. According to the types of coffee to be prepared, the particle size or grinding particle is the most important. There are many types of grinder with the adjuster to regulate the particle size of coffee grounds. During grinding the important volatile compounds are dispersed into the surroundings from the powdered coffee, so it must be executed right before the intended brewing (1–12 min after grinding) to maintain the volatile compounds [71, 72].

The coffee brewing and extraction methods differ according to the personal preference, the culture, geographical, and social and financial factors. All these brewing and extraction methods of coffee vary depending on the time of extraction, the pressure, the brewing tool, the temperature of the water, and the extraction amounts. The brewing water quality (electrical conductivity) is another important aspect for maintaining the original coffee flavour and test. The size of the coffee ground determines the rate and the total amount of extraction. If the coffee is too fine (for example super-fine) extraction will not happen as water cannot pass through, and if it is too course the grinds will be under-extracted. It depends on the coffee ground size, the coffee brewing methods also vary. Mostly for French press coffee, a coarse coffee ground is preferred, whereas the fine ground coffee is used to make the espresso coffee.

4. Conclusion

The pre-harvest and post-harvest activities starting from selecting the best quality coffee, processing, drying, hulling, storage, roasting, grinding, and brewing can influence the coffee quality. The chemical compositions and physical properties of coffee beans are affected by different factors such as environment, genetics, agronomic activities, harvesting, and post-harvest operations. Except for the genetic and environmental factor, the post-harvest process can be done in a controlled manner to maintain the chemical and physical properties of coffee and thereby maintain its quality. Generally, post-harvest activity determines the quality

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of green and/or roasted coffee beans. Each step of the post-harvest activities can cause a significant quality loss and lead to a lower market price.

Conflicts of interest

The authors declare no conflict of interest.

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